OCCURRENCE, DISTRIBUTION, AND ECOLOGY OF *ALOCASIA*, *CALADIUM*, *COLOCASIA*, AND *XANTHOSOMA* (ARACEAE) IN THE SOUTHEASTERN UNITED STATES

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ABSTRACT

Eight species in four genera of *Aroideae* (Araceae) are introduced, cultivated, and variously established in the southeastern United States. Keys, illustrations, descriptions, distribution and ranges, habitat preference, flowering and fruiting periods, and variation in both vegetative and sexual reproductive characteristics are provided for the genera, species, and varieties. Additional information on the cultivation of all species and the weedy attributes of *Colocasia* and *Xanthosoma* are discussed.

RESUMEN

Ocho especies de cuatro géneros de *Aroideae* (Araceae) están introducidas, cultivadas, y establecidas en el sureste de los Estados Unidos. Se ofrecen claves, ilustraciones, descripciones, distribución y áreas, hábitat preferente, periodos de floración y fructificación, y variación en las características vegetativas y reproductoras para los géneros, especies, y variedades. Se discute información adicional sobre el cultivo de todas las especies y las características como malas hierbas de *Colocasia* y *Xanthosoma*.

INTRODUCTION

The Araceae (including Lemnaceae; Mayo et al. 1995) or arum family is represented worldwide by 105 genera and about 3,200 species (Croat 1998; Mayo et al. 1997). At present 16 genera (excluding *Acorus* that it is now placed in the Acoraceae) and approximately 31 species occur in the continental United States and Alaska. Of these 31 species, only about

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one-half are native; the remaining exotics are established to various degrees as components of our flora. *Alocasia*, *Colocasia*, and *Xanthosoma* are among those non-native naturalized (or potentially so) genera and are represented by seven species in the United States. The origination of these genera from various tropical regions and the characteristics of the naturalized species discussed herein, imply an inherent plasticity for adaptation to different climatic conditions and habitat types. In the southeastern United States, differences in seasonal temperature range, habitat type, and floristic species composition all combine to provide some environmental deviation from the conditions in which these species evolved. Five of the eight species are experiencing some degree of range expansion since introduction, and three varieties of *Colocasia esculenta* (*Colocasia esculenta* var. *antiquorum*, *Colocasia esculenta* var. *aquatilis*, and *Colocasia esculenta* var. *nymphaeifolia*) and *Xanthosoma sagittifolium* are rapidly becoming invasive. Intraspecific morphological variability within *Colocasia*, and an overall similarity in appearance between the several varieties of *Colocasia esculenta* and certain species of *Alocasia* and *Xanthosoma* allow for continual uncertainty in field identification of this group. Ambiguity in terms of species identification and potential for invasiveness of these introduced Araceae necessitate a better understanding of their morphological and ecological variability and character in the United States.

Currently, *Alocasia macrorrhizos* and *Xanthosoma sagittifolium* are restricted in their naturalized ranges to central and southern Florida and southern Texas, while *Colocasia*, in addition to occurring throughout Florida and most of eastern Texas, also occurs in scattered locations throughout the Gulf coastal region. *Colocasia esculenta* var. *aquatilis*, *Colocasia esculenta* var. *nymphaeifolia*, and *Colocasia esculenta* var. *antiquorum* are established as far north as east central Texas, northern Louisiana, and throughout the lower one-half of Alabama, Georgia, and Mississippi. These three varieties of *C. esculenta* are invasive weeds of semi-aquatic and aquatic conditions throughout the Gulf coastal region. *Xanthosoma sagittifolium*, while not established as a serious weed, is becoming more prevalent in peninsular Florida and southern Texas.

Colocasia was introduced into the United States as a food crop for its edible tubers and for ornament, while *Xanthosoma* and *Alocasia* were introduced for their value as ornamentals with minimal consideration as a food source (Neal 1991; Vaughan & Geissler 1997). Several varieties of *Colocasia* are grown commercially for tuber production, as the tubers are a source of food and propagules for ornamental use. We would like to clarify and delineate among the intergeneric, intraspecific, and ecological differences between the species and varieties of *Alocasia*, *Caladium*, *Colocasia*, and *Xanthosoma* in the United States.

TAXONOMY

Alocasia, *Caladium*, *Colocasia* and *Xanthosoma* are currently classified in subfamily *Aroideae* (Mayo et al. 1997). These four genera are not monophyletic as once thought when formerly placed in the old subfamily *Colocasioideae*, thus paleotropical *Alocasia* and *Colocasia* remain in tribe *Colocasieae* and subtribe *Colocasiinae*, while the neotropical genera of *Caladium* and *Xanthosoma* are separated into tribe *Caladieae* and subtribe *Caladiinae* (French et al. 1995; Mayo et al. 1997). Subfamily *Aroideae* (based primarily on Croat 1988, 1998; Grayum 1994; Mayo 1997) are perennial, predominately terrestrial, rarely hemiepiphytic or epilithic herbs, which produce white or yellow to orange latex sap. Plants caulescent to acaulescent, hypogeal, stems sometimes aerial, erect to decumbent, often rhizomatous and tuberous; leaves petiolate, ovate, ovate-lanceolate, ovate-elliptic, or triangular-ovate, variously peltate or not, basally sagittate, hastate, or cordate; petioles elongate and fleshy, with the terminal petiole housing the newest unemergent leaf; venation usually reticulate, sometimes parallel-pinnate. New leaves arise singly from the apical portion of the stem and emerge from a cavity within the terminal petiole. Laticifers present, simple, articulated, or anastomosing; trichosclereids absent. Plants monoecious (occasionally polygamomonoecious), androgynous; perianth parts absent; at anthesis the spadix is usually open, with or without a terminal appendix and a region between the staminate and pistillate flowers comprised of synandrodes (sterile staminate flowers); stamens are connate and arranged in synandria; fruit a 1-numerously seeded berry, endosperm copious or not; predominately insect pollinated by various taxa of beetles, flies, and bees. Our species of *Aroideae* perenniate from subterranean tubers and or rhizomes. Production of these perenniating structures allows for efficient and prolific vegetative reproduction.

Many *Aroideae* form asexual colonies of genetically identical individuals. This is the typical method of reproduction for representative genera in the US and one of the primary factors allowing for naturalization. Seed production also occurs if environmental conditions are conducive, but this is rare in the US. Throughout the plant, but concentrated in the tubers, are deposits of poisonous capsules of pointed calcium oxylate crystals. Plants are poisonous unless cooked or prepared in such a way as to remove or neutralize the crystals. These can cause numbing and irritation of the skin and mucus membranes and problems with digestion if foliage and tubers are eaten raw or incompletely cooked (Vaughan & Geissler 1997).

KEY TO *ALOCASIA*, *CALADIUM*, *COLOCASIA*, AND *XANTHOSOMA* IN THE SOUTHEASTERN UNITED STATES

1. Leaves predominately green and tinged with purple coloration to completely purple, or green with white, pink, or red coloration (leaves rarely uniformly green in *Caladium*).
    2. Leaf margins not crenate to only slightly so; lamina variously mottled with white, pink, or red coloration, or some combination thereof ____ **Caladium**
    2. Leaf margins variously crenate or not, leaves uniformly purple or a combination of purple and green.
        3. Newly formed leaves blue-violet, lamina becoming green as they enlarge and age, midvein, primary lateral veins, and petioles violet or becoming yellow ____ **Xanthosoma**
        3. Newly formed and older leaves green, petioles green and often glaucous
            4. Veins of upper leaf surface conspicuously raised above the blade and leaf margins strongly crenate; leaves not or only slightly peltate ____ **Alocasia**

4. Veins of upper leaf surface flush with blade to slightly raised above it, the entire upper surface of the leaf appearing flat or leaf margins weakly crenate; leaves obviously peltate ________ **Colocasia**

1. Leaves essentially green, sometimes glaucous or glaucescent on the lower surface
   5. Plant arising from well-developed, subterranean tubers.
      6. Basal 2 lobes of leaves apically acute; leaves not peltate ________ **Xanthosoma**
      6. Basal 2 lobes of leaves apically rounded; leaves peltate or not.
         7. Veins of upper leaf surface conspicuously raised above the blade and leaf margins strongly crenate; leaves not peltate to peltate ________ **Alocasia**
         7. Veins of upper leaf surface flush with blade to slightly raised above it, the entire upper surface of the leaf appearing flat and leaf margins weakly crenate; leaves peltate ________ **Colocasia**
   5. Plants lacking well-developed tubers, or if tubers present then much reduced
      8. Plants producing long slender rhizomes above and or below the ground; stems arising from a slightly tuberous caudex.
         9. Basal 2 lobes of leaves rounded; rhizomes usually emerging and running for most of their length above or below ground ________ **Colocasia**
         9. Basal 2 lobes of leaves acute; rhizomes usually completely running below ground ________ **Xanthosoma**
      8. Plants not rhizomatous and caudex not tuberous ________ **Peltandra**

NOTE: *Peltandra* is included in this key because of morphological similarities and possible confusion with the other genera.

SPECIES ORIGIN, OCCURRENCE, RANGE, AND DESCRIPTION

ALOCASIA

Alocasia (Schott) G. Don in Sweet, Hort. Brit., ed. 3. 631. 1839. nom. cons; Krause in Engler, Pflanzenr. 4. 23E. 71:71. 1920. Type species (conserved): *Alocasia cucullata* (Lour.) G. Don, *Arum cucullatum* Lour.

Colocasia sect. *Alocasia* Schott in Schott & Endlicher, Melet. Bot. 18. 1832. *Ensolenanthe* Schott in Bonplandia 9. 368. 1861.
Xenophya Schott in Ann. Mus. Bot. Lugduno-Batavum 1:124. 1863.
Schizocasia Schott ex Engler in Bot. Jahrb. 1:185. 1880–1881.
Panzhuyuia Z.Y. Zhu in J. Sichuan Chinese Medicinal School 4(5):49. 1985.

Perennial caulescent or acaulescent herbs usually from a creeping tuberous-rhizome caudex, with or without elongate rhizomes, reproducing asexually by secondary tubers, tuber offshoots, and or rhizomes. Above ground stems erect to decumbent; leaves ovate to triangular-ovate, basally sagittate or rarely slightly peltate; spadix pedunculate, arising axillary and subtended by 1 or 2 acute to acuminate bracts, staminate and pistillate flowers separated by a section of synandrodes (sterile staminate flowers), appendix present; spathe present, longer than spadix, constricted basally to form a tube which encloses the spadix until anthesis; the basal portion remaining tightly closed; staminate flowers comprised of truncate synandria of 3–8 stamens; pistillate flowers 1–4 carpellate, 1–4-locular, stigma weakly 3-lobed, ovules 1-numerous, placentation basal; fruit a 1-numerous seeded berry sometimes with portions of the stigma persistent; ovules 6–10, orthotropous, hemiorthotropous, hemianatropous, or anatropous, funicles short; seed subglobose to ellipsoid, testa smooth or scabrous, endosperm copious.

About 70 species native to Indomalaysia and throughout southern Asia. Three species occur in the US. *Alocasia macrorrhizos* and *Alocasia odora* are both established.

Etymology.—*colocasia* an arum, and *alocho*, a prefix meaning bedfellow or spouse; depicting the morphological similarity between *Alocasia* and *Colocasia.*

KEY TO SPECIES OF *ALOCASIA*

1. Leaves and foliage green (foliage rarely purple in *A. macrorrhizos*, if so, then leaves not peltate).
    2. Mature leaves not peltate; leaves on juvenile plants sometimes slightly peltate ________ **1. A. macrorrhizos**
    2. Mature leaves obviously peltate ________ **2. A. odora**
1. Leaves and foliage purple, petioles sometimes green; leaves peltate ________ **3. A. plumbea**

1. Alocasia macrorrhizos (L.) G. Don var. **macrorrhizos** in Sweet, Hort. Brit., ed. 3. 631. 1839. Hook. f., Fl. Br. Ind. 6:526. 1893. Petch, Ann. Roy. Bot. Gard. Peradeniya 7:53. 1919. Krause in Engler, Pflanzenr. 4. 23E. 17:84. 1920. (**Fig. 1**). *Arum macrorrhizon* L., Sp. Pl. 965. 1753. *Caladium macrorhizon* R. Br., Prod. 336. 1810. *Alocasia macrorrhiza* (L.) Schott in Schott & Endl., Melet. Bot. 18. 1832. *Alocasia macrorrhizon* (L.) G. Don in Sweet, Hort. Brit., ed. 3. 631. 1839. *Colocasia macrorrhiza* Kunth, Enum. Pl. 3:39. 1841.

Arum peregrinum L., Sp. Pl. 966. 1753.
Arum mucronatum Lam., Encyc. 3:12. 1786.
Arum indicum Lour., Fl. Cochinch. 536. 1790. *Colocasia indica* (Lour.) Kunth, Enum. Pl. 3:39. 1840. *Alocasia indica* (Lour.) Spach, Hist. Nat. Veg. Phan. 12:47. 1846.
Arum cordifolium Bory, Voy. Iles. Afrique 1:376. 1804.
Caladium giganteum Blume, Cat. Gew. Buitenz. 103. 1823.
Arum punctatum Desf., Cat. Hort. Par., ed. 3. 385. 1829.
Caladium glycyrrhizum Fraser in Hook. Bot. Misc. 1:259. 1830.
Calla badian Blanco, Fl. Filip. 658. 1837.
Calla maxima Blanco, Fl. Filip. 658. 1837.
Arum grandifolium Blanco, op. Cit., ed. 2. 1845.
Alocasia alba Schott in Oestr. Bot. Wochenbl. 2:59. 1852.
Caladium indica Hort. ex C. Koch, Berl. Allg. Gartenz. 136. 1857.

Caulescent herbs up to 5 m in height from a tuberous caudex; stems to 1.5 m tall and 20 cm in diameter, becoming thickened and caudex-like, erect or often falling over with age and resting on the ground, basally covered with dry, chartaceous, persistent cataphylls, adventitious roots sometimes present, rhizomes present or absent, when present variable in length, elongate, white to whitish-green; leaves 35–160 cm long and 30–90 cm wide (often smaller in dimensions if on young, damaged, or spring emergent plants) ovate to ovate-triangular, apically subacute to short acuminate, basally sagittate, young leaves sometimes peltate, margins strongly undulate, primary lateral veins 4–8 per side, midvein and lateral veins prominently raised above the lamina; petioles 70–130 cm in length, lamina and petioles green; inflorescence of 1-numerous spadices, peduncles 20–50 cm long, spathe 11–35 cm long, 3.5–6.2 cm wide, chartaceous, apically withering with age, greenish-white to green or glaucous, becoming peach or light orange with age,

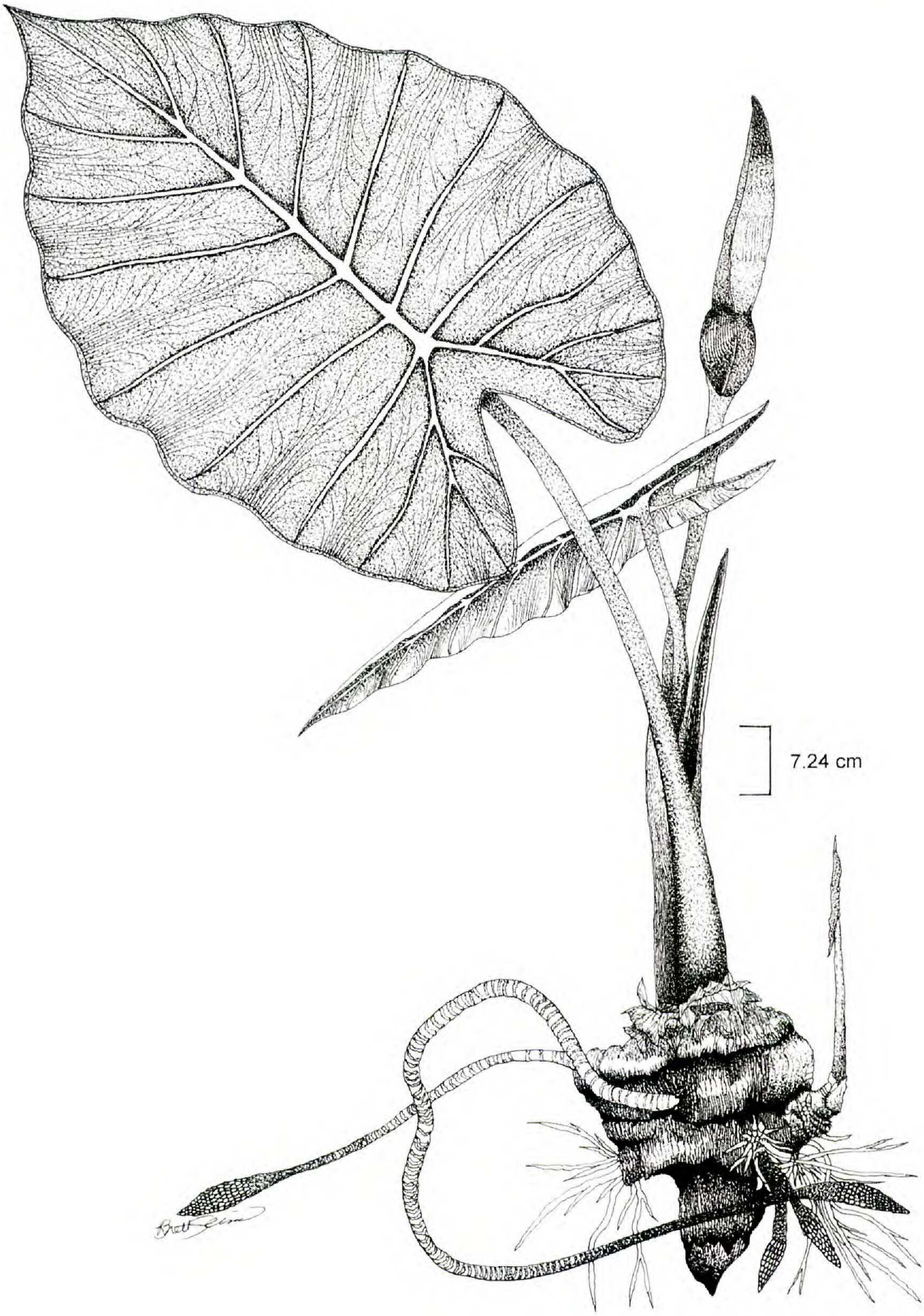

FIG. 1. *Alocasia macrorrhizos* (L.) G. Don var. *macrorrhizos*. Young plant, general habit.

spadix 11–35 cm in length, yellowish to cream, appendix 7–21 cm long, fertile staminate region 2–7 cm, sterile staminate region 0.3–2 cm long, fertile pistillate region 1.2–5 cm long, pistillate flowers emit the odor of ether prior to fertilization; berries ovoid, orange to scarlet, 8–10 mm long and 5–8 mm in diameter, usually containing 5–6 ovules.

Some species of *Alocasia*, most importantly *A. macrorrhizos* and *A. odora*, are important food crops in tropical regions, particularly Asia, the south Pacific, and to a lesser extent, Africa (Bailey 1997; Neal 1991). The actual crop and source of nutrition is the large, edible, subterranean tubers. The tubers provide high levels of dietary starch (approx. 25% by weight), ascorbic acid, low amounts of vitamin A, B complex vitamins, and small amounts of protein (Bailey 1997; Neal 1991; Vaughan & Geissler 1997). Through use as crops and ornamentals *A. macrorrhizos* and other species of *Alocasia* have been distributed and established throughout the subtropics and tropics.

Alocasia macrorrhizos was introduced into the United States from tropical Asia and occurs sporadically in central and southern Florida and southern Texas. While widely cultivated in the southern US, it is only truly established in central and southern peninsular Florida, where climatic conditions permit essentially year-round growth and little to no enforced dormancy. Its ability to reproduce vegetatively has aided naturalization. Its rate of expansion is reduced in the absence of disturbance and where soils are without adequate moisture and drainage. Once established, *Alocasia macrorrhizos* appears to tolerate a wide range of condition variability (drought, periodic flooding, variable light intensity, and occasional hard freezes) and interspecific interference. The rate of range expansion by *A. macrorrhizos* may at least in part be impeded because it usually colonizes vegetatively by secondary or daughter tuber formation. This method of establishment is not normally as conducive to invasion as is rhizome production in *Colocasia* and *Xanthosoma*. The apparent inability of *A. macrorrhizos* to produce much fruit (in the United States) for dispersal and potential long-range colonization also probably contributes to its limited expansion.

In the United States flower and fruit production typically occur from late summer into winter, though flowering can occur at any time of year. One to several inflorescences are produced per plant at any one time. *Alocasia macrorrhizos* is self compatible but probably requires out-crossing between different genotypes for full fertility (obviously environmental conditions are also important here). In the US most colonies arise from a single genotype, which may explain the apparent lack of fecundity in our plants. The lack of appropriate insect pollinators is yet another consideration. When fruit is produced the number of berries are usually few (10–15 per spadix).

Alocasia macrorrhizos prefers moderate to well-drained but continuously moist, moderately to highly acid soil. It also seems to require at least moderate disturbance for establishment. It can be found along wet woodland edges, thickets, roadsides, old fields, open areas of waste ground, vacant lots, or persisting and spreading at home sites. Once established it spreads vegetatively, by secondary tubers which produce many small plantlets or to a limited extent along tuberous rhizomes. These plantlets originate and grow for an extended period of time remaining attached to the main plant and may or may not eventually separate. *Alocasia macrorrhizos* is semi cold tolerant and can withstand limited exposure to freezing temperatures, regenerating foliage afterwards. A form with purple foliage very similar in color to *Alocasia plumbea* is sometimes cultivated and occasionally reverts back to the wild-type green coloration.

Common names.—pai, taro, cunjevoi, giant taro, ape giant, elephant-ear

2. Alocasia odora (Lodd.) Spach, Hist. Nat. Veg. Phan. 12:46. 1846; (Roxb.) K. Koch, 1.c. 1854. *Arum odorum* Roxb., Hort. Beng. 65. 1814; Roxb., Fl. Ind. 3:499.1832; Lodd., Bot. Cab. 5: t. 416. 1820; Wight, Ic. Pl. Ind. Or. 3(6): t. 797. 1844. *Caladium odoratum* Lodd., Bot Cab. t. 416. 1820. *Caladium odorum* (Lodd.) Lindl., Bot. Reg. 8: t. 641. 1822. *Colocasia odora* Hort. ex Brongn. in Nouv. Ann. Mus Par. 3. 145. 1834.

Alocasia commutata Schott in Oestr. Bot. Wochembl. 409. 1854.
Caladium odoratissimum Hort. ex C. Koch, Berl. Allg. Gartenz. 20. 1857.

Extremely similar to *Alocasia macrorrhizos* but differing by having peltate leaves and foliage often glaucescent. Also similar to *Xanthosoma sagittifolium* but basal leaf lobes are apically rounded, whereas those of *X. sagittifolium* are apically acute. *Alocasia odora* is native to southeast Asia and the Philippines and is cultivated for food and ornament throughout the tropics and for ornament in the extreme southern US. *Alocasia odora* is spontaneous in southern Florida and much of the material reported or determined as *A. macrorrhizos* is in fact *A. odora*. *Alocasia odora* is likely only a subspecies or variety of *A. macrorrhizos*. Ecology is similar to that of *A. macrorrhizos*.

Common names.—taro, elephant-ear, ape giant.

3. Alocasia plumbea Van Houtte in Fl. Des. Serres, Sér. 2. 6. 93: t. 2206. 1875.

Alocasia indica Schott in Oestr. Bot. Wochenbl. 410. 1854.
Alocasia metallica Schott in Oestr. Bot. Wochenbl. 410. 1854.

Caulescent herbs 1–3 m in height from a tuberous caudex; stem to 1 m tall, basally covered with dry, chartaceous, persistent cataphylls, rhizomes present or absent, when present variable in length, elongate, white to white-green, often tinged with pink or purple coloration; leaves 20–100 cm long and 15–65 cm wide, ovate-triangular, apically subacute to short acuminate, basally sagittate, often peltate, margins undulate, primary lateral veins 4–8 per side, midvein and lateral veins prominently raised above the lamina, petioles 40–110 cm in length, lamina adaxially dark green-purple, abaxially variable-purple, purple-green, red-brown, or yellow-green; inflorescence of 1-numerous spadices, peduncles 25–50 cm long, spathe 10–20 cm long, 3–7.5 cm wide, chartaceous, apically withering with age, purple-pink to pink, becoming peach or yellow with age and often violet-striate, spadix 10.5–19 cm in length, yellowish to cream, appendix 6.5–13 cm long, fertile staminate region 1.5–2.5 cm, sterile staminate region 0.3–0.7 cm long, fertile pistillate region 1.5–2.5 cm long, pistillate flowers emit a slight odor of ether prior to fertilization; ovary containing 3–5 ovules; fruit not observed.

Similar in form and habit to *A. macrorrhizos* but differing in its smaller and less robust stature, purple to purple-green foliage (petioles often pink or pinkish-white with purple or red spots when on young plants, or plants growing under shade conditions), and pink to lavender spathe. It is not currently naturalized in the US but is often cultivated in extreme southern Florida, Louisiana, and Texas, and readily persists subsequent to cultivation.

Common names.—purple taro, purple ape.

CALADIUM

Caladium Vent., Mag. Enc. 4(16):463. 1800–1801; Vent., Descr. Pl. Nouv. Jard. Cels 30. t. 30. 1801; Vent., Arch. Bot. (Leipzig) 2(3):347. 1801; Vent., J. Bot. (Schrader) 4(6):316. 1801. Engler, Pflanzenr. 4. 23E. 71:23. 1920. LECTOTYPE SPECIES: *Caladium bicolor* (Ait.) Vent., *Arum bicolor* Aiton.

Cyrtospadix C. Koch, Ind. Sem. Hort. Berol. 1858.
Arosma Rafin., Fl. Tellur. 3:66. 1886.
Aphyllarum S. Moore in Trans. Linn. Soc. London, Bot. Ser. 2, 4:501. 1895.

Perennial acaulescent herbs from a creeping tuberous rhizome, reproducing asexually by daughter tubers. Above ground stems erect; leaves ovate to triangular-ovate, basally sagittate, peltate; spadix pedunculate, arising axillary and subtended by 1 or 2 acuminate bracts, staminate and pistillate flowers separated by a section of synandrodes (sterile staminate flowers), appendix absent; spathe present, longer than spadix, constricted basally to form a tube which encloses the spadix until anthesis; the basal portion remaining tightly closed; staminate flowers comprised of angular synandria of 3–5 stamens; pistillate flowers 1–4 carpellate, 1–2 or incompletely 3-locular, stigma discoid, ovules 1-numerous, placentation subbasal, pseudoaxile, or parietal; fruit a 1-numerous seeded berry; ovules 1–20, anatropous, funicles short; seed ovoid to ellipsoid, testa variously costate, endosperm copious.

About 12 species all originating in the neotropics. Several species cultivated in the US, currently none established, though *C. bicolor* is widely cultivated.

Etymology.—Latin: *keladi*, of Malaysian origin, vernacular name for several Colocasioid and Caladioid genera.

Caladium bicolor (W. Ait.) Vent., Mag. Enc. 4(16):464. 1801; Vent., Descr. Pl. Nouv. Jard. Cels 30. t. 30. 1801; Vent., Arch. Bot. (Leipzig) 2(3):348. 1801; Vent., J. Bot. (Schrader) 4(6):319. 1801. Engler, Pflanzenr. 4. 23E. 71:31. 1920. (**Fig. 2**). *Arum bicolor* W. Ait., Hort. Kew. 3:316. 1789.

Caladium surinamense Miq., Delect. Sem. Hort. Amst. 3. 1853.
Caladium regale Lem., Illustr. Hort. 9. t. 316. 1862.
Caladium x hortulanum Birdsey, Cult. Aroids 42. 1951.

Acaulescent herbs from 0.2–1 m in height from a tuberous rhizome, tuberous caudex well-developed, plant without elongate stoloniferous rhizomes; leaves 5–35 cm long and 5–21 cm wide, ovate to ovate-triangular or ovate-elliptic, apically rounded to acute, basally sagittate, peltate, margins subundulate, angular, or entire; primary lateral veins

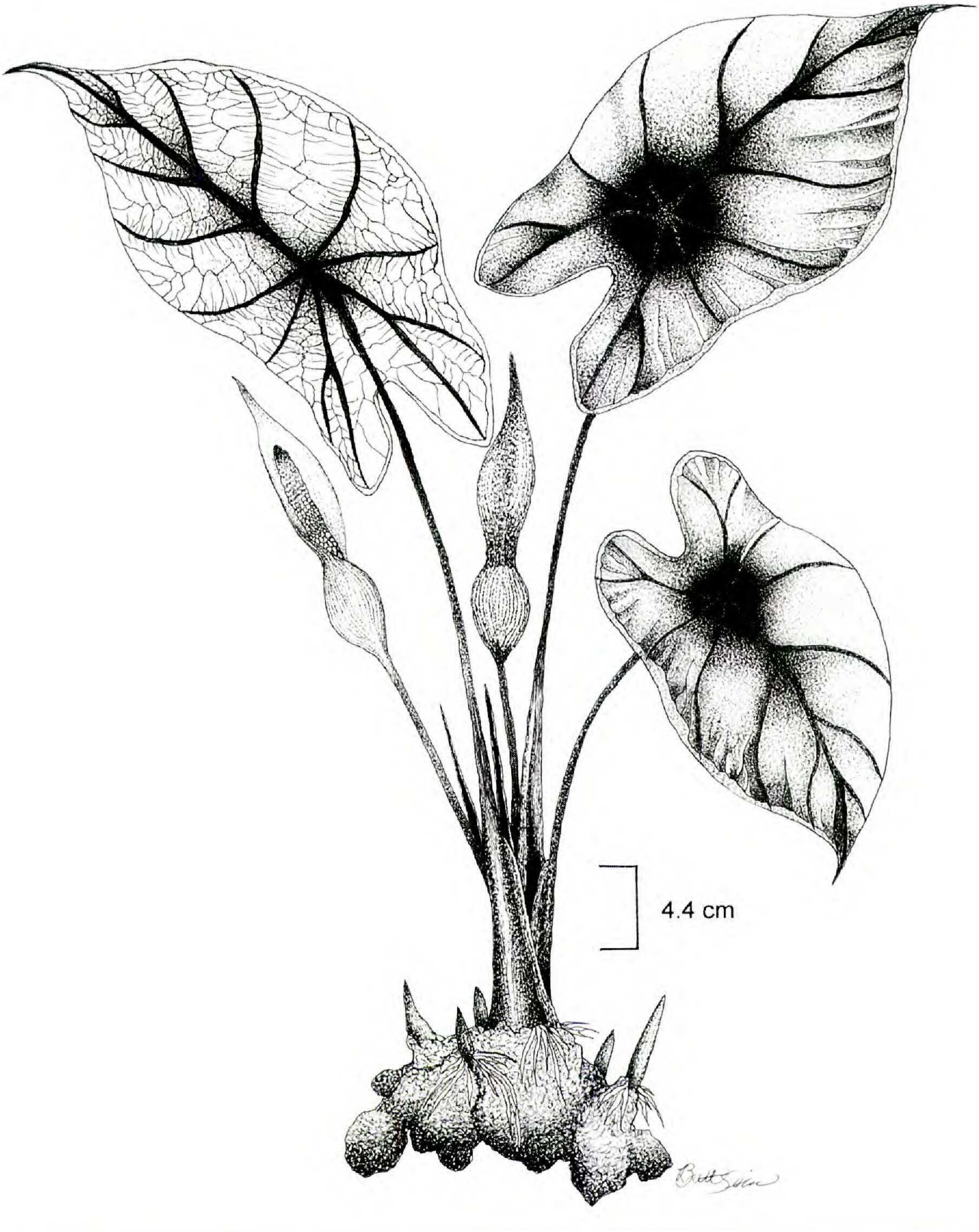

Fig. 2. ***Caladium bicolor*** **(W. Ait.) Vent. General habit.**

3–8 per side, lamina ranging in color from entirely green to green and variously mottled with white, pink, or red or some combination thereof, sometimes lamina predominately white or red, midvein and lateral veins raised above the blade on abaxial side, petiole 10–50 cm in length, green to red, purple, or black, often green and splotched with purple, sometimes pink basally; inflorescence of 1-numerous spadices, peduncles 28–40 cm long, spathe 7–25 cm long, chartaceous, broadly acute, green externally, white to white-green on the inner surface; spadix 9.5–14 cm long, white to yellowish, appendix absent or much reduced, region of fertile staminate flowers 3.5–5.5 cm long, region of sterile staminate flowers 1–2 cm long, region of fertile pistillate flowers 3.5–5 cm long, pistillate flowers essentially without odor, ovaries with 1-numerous ovules; berries white.

A highly variable species comprised of numerous varieties separated primarily on the basis of foliage coloration. Commonly cultivated in the southeastern US for ornament but not currently documented as naturalized. *Caladium bicolor* is a prolific seed producer and is spontaneous in new growth forests and moist disturbed areas throughout the tropics. It should be expected along moist disturbed sites, woodland edges, hammocks, and fields in southern Florida.

Common names.—caladium, elephant's-ear, angel-wings, mother-in-law plant.

COLOCASIA

Colocasia Schott in Schott and Engl., Melet. Bot. 18. 1832, nom. cons; Krause in Engler, Pflanzenr. 4. 23E. 71:62. 1920. TYPE SPECIES (conserved): *Colocasia antiquorum* Schott, *Arum colocasia* L., *Colocasia esculenta* (L.) Schott.

Leucocasia Schott in Oestr. Bot. Wochenbl. 7:34. 1857.

Perennial caulescent to acaulescent herbs from a creeping tuberous-rhizome; tubers and rhizomes usually present; asexual reproduction by means of secondary or daughter tubers, and or rhizomes. Above ground stems erect; leaves ovate to triangular-ovate, basally cordate, cordate-sagittate, or sagittate, typically peltate, often glaucous to glaucescent abaxially; spadix pedunculate, arising axillary and subtended by 1 or 2 acute to acuminate bracts, staminate and pistillate flowers separated by a section of synandrodes (sterile staminate flowers), appendix present; spathe present, 2–6 times longer than spadix, constricted basally to form a tube which encloses the spadix until anthesis; the basal portion remaining tightly closed; staminate flowers comprised of truncate synandria of 3–6 stamens; pistillate flowers 1-locular, stigma discoid-capitate or weakly lobed, ovules numerous, placentation parietal; fruit a 1-numerous seeded berry with a persistent stigma; ovules numerous, hemiorthotropous, funicles long; seed ovoid to ellipsoid, testa costate, endosperm copious.

Seven or eight species primarily of tropical Asia, some in Africa. Two species established in the US but only certain varieties of *Colocasia esculenta* widely naturalized.

Etymology.—Greek: *kolokasia*, term used for the root of *Nelumbo nucifera* Gaertn. (water lotus) (Nelumbonaceae), thus applied to *Colocasia* because of its edible tubers.

KEY TO SPECIES OF *COLOCASIA*

1. Leaves and foliage predominately to entirely green, often somewhat glaucous on the lower surface, petioles and lamina sometimes with a reddish or purplish tinge; plants well-established in southeastern United States.
   2. Rhizomes up to 25 dm long; tubers usually poorly developed or nearly absent; widely naturalized (some material of *C. esculenta* var. *antiquorum* will key here).

3. Rhizomes originating at apex or middle of tuber body ______ **1. C. esculenta var. aquatilis**
3. Rhizomes originating only at very base of tubers _____ **8. C. esculenta var. nymphaeifolia**

2. Rhizomes often reduced in length or absent; tubers normally large and well-developed.
4. Tubers large, few; terminal appendage of spadix short or nearly absent; rhizomes usually short or absent ____________________ **3. C. esculenta var. esculenta**
4. Tubers small, few to numerous, often with short or long rhizomes, occasionally rhizomes up to 25 dm long; terminal appendage of spadix elongated.
5. Plants of aquatic areas; relatively wide-spread _____ **2. C. esculenta var. antiquorum**
5. Plants of upland areas with well-drained soils, often occurring and persisting along field edges where cultivated but rarely occurring outside these areas ________________________________ **6. C. esculenta var. globulifera**

1. Leaves with purplish or blackish coloration, or white-glaucous on the under surface; plants not truly naturalized in the United States.
6. Leaves white-glaucous on the lower surface and lacking purple coloration, veins usually whitish; spathe white to cream ______________________ **9. C. gigantea**
6. Leaves not white-glaucous on lower surface, may be glaucous-green, blue or purple, and at least with some purple coloration on veins and or blade, veins never with white coloration; spathe yellow-green to orange, or pink.
7. Leaves green on upper surface (sometimes tinged with purple), petioles and lower surface veins purple or purple-black, leaf margins usually purple.
8. Lamina dark green, almost appearing tinged with purple; leaves with purple veins on the lower surface, with or without purple margins; plants large, often 1.5–2.0 m tall ______________________ **5. C. esculenta var. fontanesii**
8. Lamina bright green; leaves usually with veins purple, sometimes green on the lower surface, margins purple; plants small, usually 1 m or less tall ______________________ **4. C. esculenta var. euchlora**
7. All or at least part of the upper surface of leaves dark purple to purple-black
9. Leaves completely purple at maturity, almost black, glaucous-purple on the lower surface, primary veins dark purple to purple-black ____ **5. C. esculenta var. fontanesii**
9. Leaves green with spots or broad bands of purple between the veins on the upper surface, glaucous-green on the lower surface, primary veins green ______________________ **7. C. esculenta var. illustris**

Another variety of *Colocasia esculenta*—*C. esculenta* var. *acris* (R.Br.) A.F. Hill, Bot. Mus. Leafl. 7:7. 1939. *Caladium acre* R. Br., Prodr. Fl. Nov. Holl. 336. 1810. *Colocasia acris* Schott in Schott & Endl., Melet. Bot. 18. 1832. *Colocasia antiquorum* Schott var. *acris* Schott, Syn. Aroid. 42. 1856; Prodr. Syst. Aroid. 140. 1860; Engl. in A. DC. Monogr. Phan. 2:492. 1879; Engler & Krause in Engl., Pflanzenr. 4. 23E. 71:68. 1920—differs from the above varieties by the absence of an appendix.

Colocasia esculenta (L.) Schott in Schott & Endl., Melet. Bot. 18. 1832; Kunth, Enum. 3:57. 1841. *Arum esculentum* L., Sp. Pl. 1753. *Caladium esculentum* (L.) Vent., Mag. Enc. 4:471. 1801; Vent., Descr. Pl. Nouv. Hort. Cels t. 30. 1801; Vent. J. Bot. (Schrader) 4:319. 1801. *Colocasia antiquorum* (L.) Schott in Schott & Endl., Melet. Bot. 18. 1832; Kunth, Enum. 3:37. 1841; Hook. f. in Bot. Mag. t. 7364. 1894; Engler & Krause in Pflanzenr., 4. 23E. 65. 1920.

This species is divided into numerous varieties and over 300 forms or land races primarily on the basis of vegetative differences (Engler & Krause 1920; Hill 1939; Neal 1991). The primary criteria for varietal separation are: size, shape, color, and number of tubers produced, texture and chemical composition of tubers, degree of rhizome formation, and foliage morphology and coloration. Flower and fruit characters are also used. Varieties are used as ornamentals or as food crops for the edible, high carbohydrate tuberous rhizomes; some varieties are also invasive weeds. Spadix morphology and color can vary depending on variety. Flesh of tubers ranges in color from white, yellow, lilac-purple, or pink to reddish. Varieties of *Colocasia esculenta* are separated into two groups based on differential affinities for available soil or substrate moisture. Aquatic or wetland varieties prefer aquatic or semi-aquatic conditions of continual soil saturation, while upland forms prefer well-drained but continually moist soils. Both groups will survive under either set of conditions. Vegetative propagation occurs by division of the caudex, new secondary or daughter tubers, rhizome fragments, and buli (top one-third of tuber and 12–20 cm of stem; Neal 1991). Propagation by seed is also effective.

In 1939, A.F. Hill published: *The nomenclature of the taro and its varieties*, showing *Colocasia esculenta* (L.) Schott, 1832 to be an earlier name than *Colocasia antiquorum* Schott, 1832. The species was originally described by Linnaeus as *Arum esculentum*, Sp. Pl. 965. 1753. Our varieties of *Colocasia esculenta* along with synonymy and specific varietal attributes are discussed below.

Varieties *aquatilis*, *antiquorum*, and *nymphaeifolia* differ only slightly in their morphology. Variety *antiquorum* is most easily separated, differing by having petioles often nearly green in color, usually greater tuber development, and less developed rhizomes, whereas both *aquatilis* and *nymphaeifolia* have petioles usually with pronounced reddish or purple coloration, often little to nearly no tuber development, and long, well-developed rhizomes. Varieties *aquatilis* and *nymphaeifolia* essentially differ from each other only in area of origination of rhizomes from the tuber or caudex (see key to species of *Colocasia*). These three varieties intergrade appreciably in form and ecology and probably encompass only a single, highly variable taxon.

1. Colocasia esculenta (L.) Schott. var. **aquatilis** Hassk., Pl. Jav. Rar. 150. 1848. (**Fig. 3**). *Caladium aquatile* Rumph., Herb. Amboin. 5:313. t. 110. f. 1. 1747. *Colocasia antiquorum* Schott var. *aquatilis* Hassk. in Engl., Pflanzenr. 4. 23E. 71:68. 1920.

Colocasia antiquorum Schott var. *stolonifera* (Haines) H.B., Nathani, Flou. Pl. India, Nepal and Bhutan. 454. 1990.

Colocasia esculenta (L.) Schott var. *stolonifera* (Haines) H.B., Nathani, Flou. Pl. India, Nepal and Bhutan. 454. 1990.

Essentially acaulescent herbs to 1.5 m in height from a slightly tuberous caudex, tuberous caudex usually poorly developed to nearly absent, well-developed rhizomes present to 2.5 m in length, elongate, brittle, and covered with tan scale-like cataphylls, distal portion greenish-white and usually lacking the cataphyll covering; leaves 7–40 cm long and 5–30.5 cm wide, ovate, ovate-triangular, or ovate-elliptic, apically rounded to acute, basally cordate, cordate-sagittate, or sagittate, peltate, margins weakly undulate to entire; primarily lateral veins 3–8 per side, ranging in color from green to yellow, or purple, midvein and lateral veins even or minutely raised above the blade on adaxial side of leaf, blade

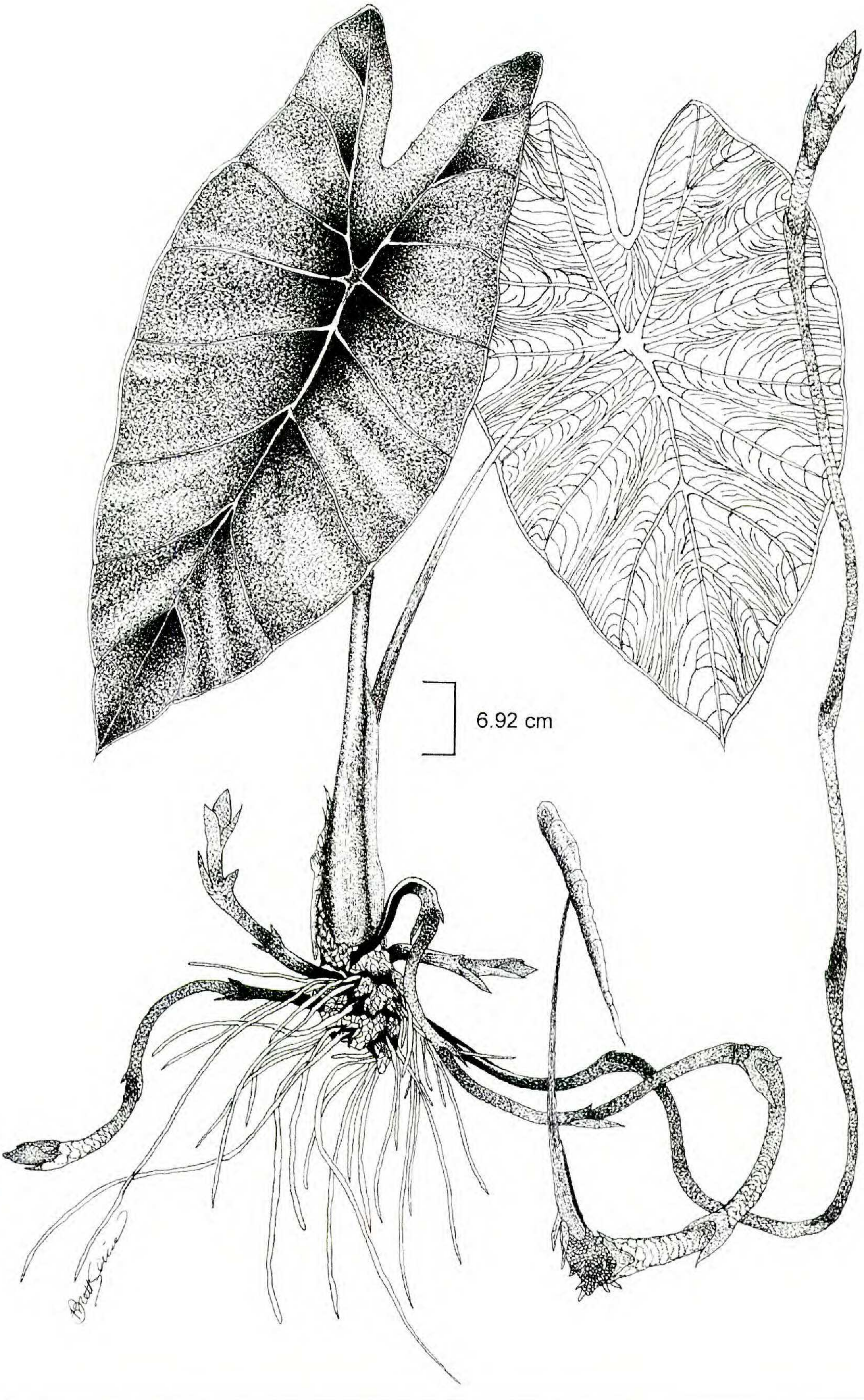

FIG. 3. *Colocasia esculenta* (L.) Schott var. *aquatilis* Hassk. General habit.

glaucous to glaucescent abaxially, petiole 40–180 cm in length, green to red or purple, often green and splotched with purple, sometimes pink basally; inflorescence of 1-numerous spadices, peduncles 15–50 cm long, spathe 10–40 cm long, chartaceous, broadly acuminate, yellow-green, yellow, yellow-orange, or orange; spadix 6–14 cm long, yellow-cream and often tinged with orange or pink, appendix 0.5–3 cm long, region of fertile staminate flowers 2–4 cm long, region of sterile staminate flowers 1.5–5 cm long, region of fertile pistillate flowers 1–2.5 cm long, pistillate flowers essentially without odor; berries red, ellipsoid to oblong and 3–7 mm in diameter.

Originally from southeast Asia, this variety along with varieties *antiquorum* and *nymphaeifolia* have become pantropical weeds of aquatic habitats, particularly rice fields, fresh water marshes, lake and waterway margins, and drainage sloughs. It is truly aquatic and cannot tolerate prolonged conditions of drought without the onset of dormancy. Extended drought over several months usually induces plant fatality. It was introduced into the United States as an ornamental and is completely naturalized as a member of our flora. *Colocasia esculenta* var. *aquatilis* has become an invasive weed in the southeastern U S. It ranges from eastern Texas, to Louisiana, Mississippi, and Alabama, throughout Florida and north to Georgia. Variety *aquatilis* is the most established of the varieties of *Colocasia esculenta* in the United States. Though potentially invasive under any conditions with adequate moisture, the habitat preferences of variety *aquatilis* in the southeast US are continually wet or flooded roadside ditches; freshwater marshes; open areas of floodplains; fresh water beaches, and shallow water along the edges of ponds, lakes, streams, and slow moving waterways. Any environment with shallow standing water or continually wet soil is a potential habitat. Variety *aquatilis* requires little to no disturbance for establishment. It has the potential to aggressively invade and quickly establish vegetative colonies regardless of the floristic component or degree of disturbance. Small colonies and isolated juvenile plants seem to indicate that spread is because of vegetative propagule (rhizome fragments) fragmentation, translocation, and subsequent plant regeneration. This scenario is further supported because of the lack of fruit production in the US by *Colocasia esculenta*.

Although roughly similar in form to *Alocasia macrorrhizos* and *Xanthosoma sagittifolium*, variety *aquatilis* is smaller and generally has more vigorous rhizome production. These stoloniferous rhizomes are capable of producing several plants along their length (up to one per node). Typically only one or two plantlets are produced at the rhizome terminus. Each plant can produce 2–10 or more rhizomes at any one time. Rhizomes are brittle and sever with minimal disturbance. Separation of rhizomes stimulates additional rhizome production. Rhizomes severed before leaves or roots have emerged from the nodes can root and produce new plants on moist soil or in standing water. Extensive colonies of variety *aquatilis* occur throughout Florida, but are otherwise currently restricted to a zone approximately 100 miles inland from the Gulf of Mexico. Some isolated and localized populations occur slightly farther inland and northward. Tuber development is usually reduced or almost absent, the subterranean portion usually only consisting of many fleshy fibrous roots and rhizomes. Large specimens sometimes have more pronounced tuber development at the crown region. Plants with larger more developed tubers (see *Colocasia esculenta* var. *antiquorum*) are not uncommon. Once rhizomes begin to elongate, they often emerge from the soil and become stoloniferous, rooting along the nodes and producing new plantlets. At various lengths, the rhizomes sometimes repenetrate the given substrate. New colonies are nearly exclusively founded by translocation and subsequent establishment of nodal rhizome fragments or small plantlets.

Variety *aquatilis* only occasionally produces flowers in the United States. Flowering usually occurs in mid to late summer (late June through September or October), during which time conditions are dry throughout much of the southeastern US. If the site occupied becomes moderately dry, flowers are often produced. Usually 1–3 inflorescences are produced. Plants will sometimes also flower in wet conditions. Fruit is not normally produced in the continental US and dispersal and colony establishment by seed is rare or absent.

Colocasia esculenta var. *aquatilis* is propagated readily by plantlet division from rhizomes. Plantlets can be removed immediately after emergence from the rhizome so long as the node from which the plantlet originated is left attached, even leafy stem sections with a functioning apical meristem will usually root in water or wet soil. It can be grown with or without soil as long as standing water is provided, but establishment and growth is enhanced with some type of rooting medium. Plants thrive on excess nitrogen and phosphorous. Mature plants transplant readily.

A variegated form of variety *aquatilis* with irregular lutescent areas of yellow to white on leaves and petioles, occurs infrequently within wild-type populations.

Common names.—aquatic elephant-ear, elephant's-ear, wild taro.

2. **Colocasia esculenta** (L.) Schott var. **antiquorum** (Schott) Hubb. & Rehd. in Bot. Mus. Leafl. 1:1.5. 1932. *Colocasia antiquorum* Schott in Schott & Endl., Melet. Bot. 18. 1832; Schott, Syn. Aroid. 41. 1856; Schott, Prodr. Syst. Aroid. 138. 1860; Kunth, Enum Pl. 3:37. 1841; Engl. in A. DC., Monogr. Phan. 2:491. 1879; Hook. f. in Bot. Mag. 120. t. 7364. 1894; Engl. & Krause in Engl., Pflanzenr. 4. 23E. 71:65. 1920.

Arum aegyptium Rumph., Herb. Amboin. 5:313. t. 109. 1747.
Arum colocasia L., Sp. Pl. 965. 1753.
Arum peltatum Lam., Encyc. 3:13. 1786.
Arum lividum Salisb., Prodr. Stirp. Chap. Allerton 260. 1796.
Colocasia peregrina Rafin., Fl. Tellur. 3:65. 1836.
Colocasia vulgaris Rafin., Fl. Tellur. 3:65. 1836.
Caladium colocasia W.F. Wight in Contr. U.S. Natl. Herb. 9:208. 1905.

Nearly identical in morphology and habit to varieties *aquatilis* and *nymphaeifolia*, variety *antiquorum* differs primarily on the basis of its nearly green petioles, larger tubers (especially those at the crown) and usually shorter, less developed rhizomes, though these can approach the length and development of rhizome formation in varieties *aquatilis* and *nymphaeifolia*.

Introduced for its edible tubers and as an ornamental from southeast Asia, *Colocasia esculenta* var. *antiquorum* is naturalized in the southeastern US but is less widespread than variety *aquatilis*. Variety *antiquorum* prefers margins of ponds and lakes, but will also rapidly colonize and invade lawns, flower beds, and other disturbed sites so long as adequate soil moisture is present. Establishment and complete invasion of various lawns and gardens was observed in Baton Rouge, Louisiana, in 1998 by both varieties *antiquorum* and *nymphaeifolia*. Plants prefer moist to saturated soil or shallow water and usually do not occur in water over 30 cm deep.

The primary mode of reproduction is vegetative and occurs from secondary tubers, or plantlets produced from rhizomes. Variety *antiquorum* requires similar conditions for growth, colonization and expansion, and flowering as variety *aquatilis*. Flower morphology is similar to variety *aquatilis*, and as in variety *aquatilis*, fruit is not normally produced in the continental US. It seems to withstand somewhat drier conditions than variety *aquatilis*. It occurs from east-central Texas, east to the Atlantic coast, and from Georgia southward throughout Florida.

Common names.—Egyptian taro, culgas, qolqas, black taro, eddoe, eddo, kalo, elephant-ear.

3. Colocasia esculenta (L.) Schott var. **esculenta** Schott, Syn. Aroid. 42. 1856. *Arum esculentum* L., Sp. Pl. 965. 1753. *Caladium esculentum* (L.) Vent., Descr. Pl. Nouv. Jard. Cels 30. t. 1800; Vent., Mag. Enc. 4:471. 1801; Vent., J. Bot. (Schrader) 4:319. 1801. *Colocasia antiquorum* Schott var. *esculenta* Schott, Syn. Aroid. 42. 1856; Schott, Prodr. Syst. Aroid. 140. 1860; Engl. in A. DC., Monogr. Phan. 2:492. 1879; Engl. & Krause in Engl., Pflanzenr. 4. 23E. 71:67. 1920.

Arum maximum Bauhin in Verh. Batav. Gen. 4. 1790.
Colocasia esculenta (L.) Schott var. *typica* Engl., Vers. Entwicklungsgesch. Extratrop. Florengeb. 8. 1879.

Variety *esculenta* is the most common ornamental form grown in the US and is characterized by its large tubers (up to 22 cm long and 18 cm in diameter), leaves, and size (to 2 m or more tall). Usually only a few tubers are produced per plant at any one time. *Colocasia esculenta* is the most important species of Araceae in terms of food production worldwide (Bailey 1997; Vaughan & Geissler 1997; Neal 1991). The tubers have a high starch content (approx. 25%), some protein, and 13 mg/100 g vitamin C. Small secondary tubers, also known as cormels, are equally consumed (Vaughan & Geissler 1997). Secondary tubers develop directly from the primary caudex or at the nodes or terminus of rhizomes. The foliage is also eaten and normally contains 7 mg/100 g carotene, and 52 mg/100 g vitamin C; all parts of the plant are used as food in certain regions of Africa and Asia. Removal of calcium oxylate from the tubers is accomplished through boiling (Vaughan & Geissler 1997; Neal 1991). Chemical composition of the tubers produced by *Colocasia* is similar to those of *Alocasia* and *Xanthosoma* (Vaughan & Geissler 1997). *Colocasia* is grown as a food source in the United States and Mexico, throughout the neotropics, Africa, and Asia. It is a staple food crop in many areas of Africa where it is known as cocoyam (Vaughan & Geissler 1997; Neal 1991). The amount of tuber production varies with varietal type, soil texture, environmental conditions, and health of the plant (Young 1946).

Common names.—taro, elephant-ear, elephant-plant.

4. Colocasia esculenta (L.) Schott var. **euchlora** (C. Koch and Sello) A.F. Hill, Bot. Mus. Leafl. 7:7. 1939. *Colocasia euchlora* C. Koch and Sello in Ind. Sem. Hort. Bot. Berol. App. 4. 1854. *Colocasia antiquorum* Schott var. *euchlora* Schott, Syn. Aroid. 42. 1856; Schott, Prodr. Syst. Aroid. 140. 1860; Engl. in A. DC. Monogr. Phan. 2:491. 1879; Engl. & Krause in Engl. Pflanzenr. 4. 23E. 71:67. 1920.

Plant to 92 cm tall, leaves with lamina bright green, margins usually purple, petioles and veins red to purple. Rhizomes similar to those of varieties *aquatilis* or *nymphaeifolia* but red or purple in color and usually shorter. Similar to variety *fontanesii* in coloration but smaller. Vegetative reproduction by rhizomes and secondary tubers. Grown in extreme southern US but no current record of establishment outside cultivation.

Common name.—purple-stemmed taro.

5. Colocasia esculenta (L.) Schott var. **fontanesii** (Schott) A.F. Hill, Bot. Mus. Leafl. 7:7. 1939. *Colocasia fontanesii* Schott in Oestr. Bot Wochenbl. 4. 409. 1854. *Colocasia antiquorum* Schott var. *fontanesii* Schott, Syn. Aroid. 42. 1856; Schott, Prodr. Syst. Aroid. 140. 1860; Engl. in A. DC., Monogr. Phan. 2:491. 1879; Hook. f. in Bot. Mag. 126. t. 7732. 1900; Engl. & Krause in Engl. Pflanzenr. 4. 23E. 71:67. 1920.

Arum colocasioides Desf., Cat. Hort. Par. ed. 3. 7. 385. 1829.
Caladium violaceum Hort. ex Engl. in DC. Monogr. Phan. 2:492. 1879; Desf., Cat. Hort. Par. ed. 3. 7. 1829.
Caladium colocasioides Hort. Par. ex Brongn. in Nouv. Ann. Mus. Par. 3. 156. 1834; Kunth, Enum. Pl. 3:43. 1841.
Colocasia violacea Hort. ex Hook. f. in Bot. Mag. 126. t. 7732. 1900.

Nearly identical in form to variety *euchlora*, but larger—to 2.14 m tall, and more robust with the petioles and veins of leaf usually black or dark purple; lamina dark green, often tinged with purple coloration. Rhizomes similar to varieties *aquatilis* and *nymphaeifolia*, but purple to purple-black and thicker. A form with completely purple to purple-black foliage is also cultivated in the US. Lamina, petioles, peduncles, and spathe all purple, undersurface of leaf glaucous-purple, roots often with pink or purple coloration. Leaves on plants grown under shade conditions and newly emergent leaves are blue-green with purple coloration along veins and petioles. Newly emergent leaves on juvenile plants sometimes green. This form actually appears to be an intervarietal cross between varieties *fontanesii* and *illustris*—being phenotypically intermediate between the two. Both forms are vegetatively aggressive similar to varieties *aquatilis* and *nymphaeifolia*. Cultivated in extreme southern US and observed spreading vegetatively at these sites but no record of establishment outside cultivation. It is another potentially weedy variety.

Common Names.—black-stemmed taro, black taro, purple taro, black magic taro.

6. Colocasia esculenta (L.) Schott var. **globulifera** (Engl. & Krause) Young in U.S. Dept. Agric. Dept. Bull. 8:1247. 1924. *Colocasia antiquorum* Schott var. *globulifera* Engl. & Krause in Engl. Pflanzenr. 4. 23E. 71:68. 1920.

This upland variety is grown commercially in the US for its small edible tubers. Individual plants normally produce 20 or more 2–10 cm long secondary tubers terminating short rhizomes or originating from the primary caudex. Plants to 95 cm tall. Variety *globulifera* is not well-established in the US but does occur and persist near areas where it is in production.

Common name.—dasheen.

7. Colocasia esculenta (L.) Schott var **illustris** (Bull.) A.F. Hill, Bot. Mus. Leafl. 7:7. 1939. *Alocasia illustris* Bull., Cat. 4. 1873; Bull. in Flor. Mag. t. 107. 1874. *Colocasia antiquorum* Schott var. *illustris* Engl. in A. DC. Monogr. Phan. 2:492. 1879; Engl. & Krause in Engl. Pflanzenr. 4. 23E. 71:67. 1920.

Plants to 1m tall and resembling varieties *aquatilis* and *nymphaeifolia* in form but less aggressive and usually with shorter, more tuberous rhizomes. Newly formed rhizomes are more slender than those of varieties *aquatilis* or *nymphaeifolia*. Leaves with lamina green and spotted to completely purple between primary veins, primary veins green, lamina glaucous abaxially, petioles green with red or red-brown coloration or completely red. Variety *illustris* is cultivated in the extreme southern US. It is not currently naturalized but spreads locally where cultivated and could potentially be invasive under favorable conditions.

Common names.—Imperial taro, black caladium.

8. Colocasia esculenta (L.) Schott var. **nymphaeifolia** (Vent.) A.F. Hill, Bot. Mus. Leafl. 7:7. 1939. **(Fig. 4).** *Caladium nymphaeifolium* Vent., Descr. Pl. Nouv. Jard. Cels sub t. 30. 1800; Willd., Sp. Pl. 4. 488. 1805. *Arum nymphaeifolium* Roxb., Hort. Beng. 65. 1814; Roxb., Fl. Ind. 3:495. 1814. *Colocasia nymphaeifolia* Kunth, Enum. Pl. 3:87. 1840. *Colocasia antiquorum* Schott var. *nymphaeifolia* Schott, Syn. Aroid. 42. 1856; Schott, Prodr. Syst. Aroid. 140. 1860; Engl. in A. DC., Monogr. Phan. 2:492. 1879; Engl. & Krause in Engl., Pflanzenr. 4. 23E. 71:67. 1920.

Practically identical in form and habit to variety *aquatilis* (see varietal discussion following *Colocasia esculenta*) but differs by producing rhizomes exclusively from the base of tubers. Similar range and ecology as var. *aquatilis* but seemingly less common.

Common names.—aquatic elephant-ear, taro.

9. Colocasia gigantea (Blume) Hook. f., Fl. Britt. Ind. 6:524. 1893.

Caulescent, erect, terrestrial or epilithic herbs to 2 m or more in height from a tuberous caudex. Leaves 20–120 cm long and 15–90 cm wide, ovate, apically rounded to acute, basally cordate, cordate-sagittate, or sagittate, peltate, apices short-acuminate, margins undulate; primarily lateral veins 4–8 per side, lamina green, petiole 20–150 cm in length, light green, white-pruinose; inflorescence of 1-numerous spadices, peduncles 20–55 cm long, spathe 25–50 cm long, chartaceous, short-acuminate, white; spadix 8–23 cm long, yellowish, appendix 3–6 mm long, region of fertile staminate flowers 2–9.5 cm long, region of sterile staminate flowers 2–4.5 cm long, region of fertile pistillate flowers 4–8 cm long; berries oblong to 1 cm in diameter.

Colocasia gigantea is similar to *Colocasia esculenta* and *Alocasia macrorrhizos*, and is included here to alleviate any confusion in identification of plants encountered. This species is rarely cultivated and not currently established outside cultivation in this country. Native to Java.

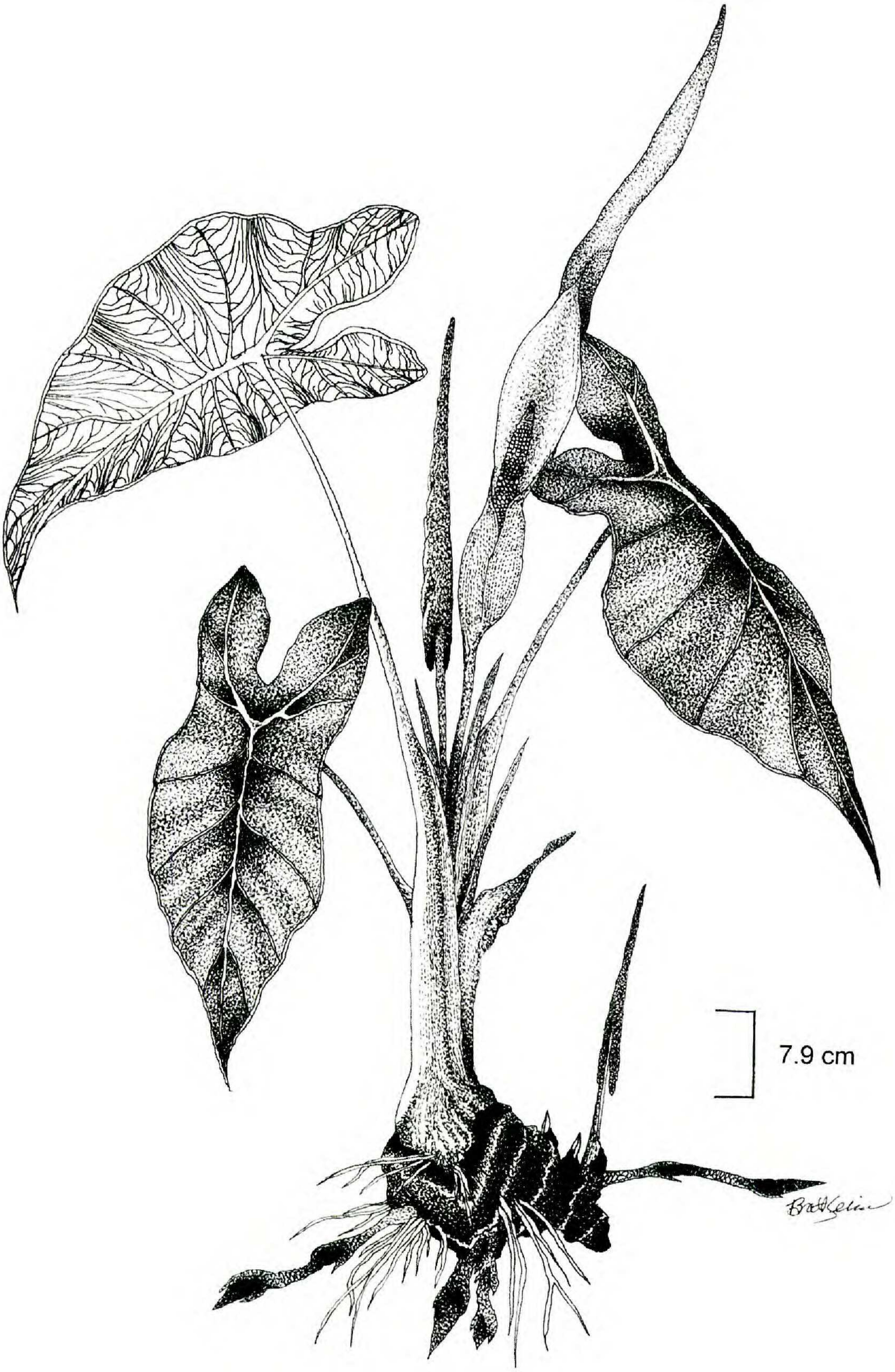

FIG. 4. *Colocasia esculenta* (L.) Schott var. *nymphaeifolia* (Vent.) A.F. Hill. General habit.

Common names.—giant taro, elephant-ear.

XANTHOSOMA

Xanthosoma Schott in Schott & Endl., Melet. Bot. 19. 1832; Engler Pflanzenr. 4. 23E. 71:41. 1920. LECTOTYPE SPECIES: *Xanthosoma sagittifolium* (L.) Schott, *Arum sagittifolium* L.

Acontias Schott, Melet. Bot. 19. 1832.
Phyllotaenium André in Illust. Flortic. 19:3. t. 88. 1872

Perennial caulescent to acaulescent herbs, with or without a tuberous caudex. Tubers and or rhizomes typically present, asexual reproduction by means of secondary or daughter tubers and or rhizomes. Above ground stems erect to decumbent; leaves ovate, triangular-ovate to ovate-elliptic, long petioled, basally hastate, three to several lobed or pedatisect, leaves and stems glaucous or not; spadix pedunculate, arising axillary and subtended by 1 or 2 acute to acuminate bracts, staminate and pistillate flowers separated by a section of synandrodes (sterile staminate flowers), sterile appendix reduced or absent; spathe present, 1–3 times longer than spadix, constricted basally to form a tube which encloses the spadix prior to anthesis, the basal portion remaining tightly closed; staminate flowers comprised of synandria of 4–6 stamens; pistillate flowers 1-carpellate, 2–4-locular, stigma discoid, ovules numerous, placentation pseudoaxile or parietal; fruit a cylindrical, furrowed berry; ovules usually 12–20, but can be numerous, anatropous or hemianatropous, funicles long; seed ovoid, testa costate, endosperm copious.

About 58 species originating in the neotropics. Currently only *X. sagittifolium* is naturalized in the United States.

Etymology.—Greek: *xantho*, the color yellow and *soma*, a body; yellow body—probably in reference to the yellow color of various stem tissues.

KEY TO SPECIES OF *XANTHOSOMA*

1. Leaves entirely green to green-blue, young leaves green to green-blue; petioles green to glaucous ____ **1. X. sagittifolium**
1. Leaves green but margins and veins usually purple, young leaves blue-purple to primrose; petioles often purple but can be yellow-green ____ **2. X. violaceum**

1. Xanthosoma sagittifolium (L.) Schott in Schott & Endl., Melet. Bot. 19. 1832; Engler, Pflanzenr. 4. 23E. 71:45. f. 9A. 1920. (**Fig. 5**). *Arum sagittifolium* L., Sp. Pl. 966. 1753. *Arum sagittaefolium* L., 1.c., ed. 2, 1369. 1763. *Caladium sagittifolium* (L.) Vent., Mag. Enc. 4(16):471. 1801; Vent., Arch. Bot. (Leipzig) 2(3):351. 1801; Vent., J. Bot. (Schrader) 4(6):319. 1801. *Caladium sagittaefolium* (L.) Willd., Sp. Pl. 4:489. 1805; Spreng. Syst. Veg. 3:771. 1826. *Xanthosoma sagittaefolium* (L.) Schott in Schott & Endl., Melet. Bot. 19. 1832.

Arum acaule Plum., Pl. Amer. t. 35. 1756.
Arum triangularis Plum., Pl. Amer. t. 35. 1756.
Arum xanthorrhizon Jacq., Pl. Hort. Schoenbr. 2:32. 1797. *Caladium zanthorrhizom* (Jacq.) Willd., Sp. Pl. 4:490. 1805. *Xanthosoma xanthorrhizon* (Jacq.) C. Koch, Bonplandia 4:4. 1856.
Caladium edule G.F.W. Mey, Fl. Esseq. 272. 1818. *Xanthosoma edule* (G.F.W. Mey) Schott in Schott & Engl., Melet. Bot. 19. 1832.

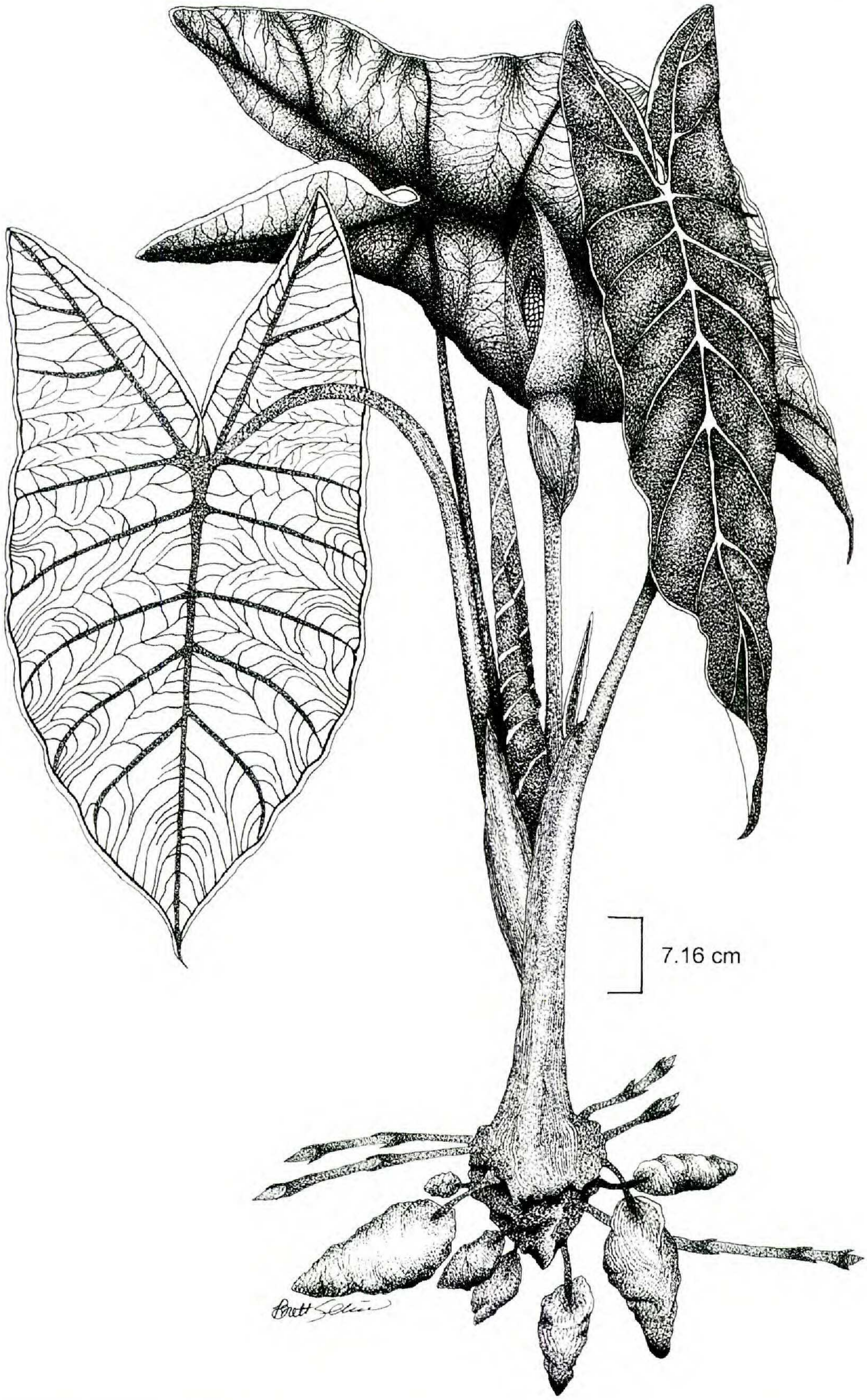

Fig. 5. *Xanthosoma sagittifolium* (L.) Schott. General habit.

Xanthosoma atrovirens C. Koch and Bouché, Ind. Sem. Hort. Berol. 3. 1854.
Xanthosoma utile C. Koch & Bouché, Ind. Sem. Hort. Berol. 2. 1854.
Xanthosoma zanthorrhizon C. Koch, Bonplandia 4:4. 1856.
Xanthosoma wendlandii Schott in Oestr. Bot. Zeitschr. 15:3. 1865.
Caladium utile Hort. ex Engl. in A. DC. Monogr. Phan. 2:469. 1879.

Caulescent herbs to 3.5 m in height from a tuberous caudex, tubers and tuberous caudex poorly developed or absent in juvenile plants; well-developed rhizomes present to 1 m or more in length, elongate, slender, without scaly covering of cataphylls, often tuberous at various places along the length, white and often tinged with light green; leaves 20–120 cm long and 15–90 cm wide, ovate to triangular-ovate, apically acute to acuminate, basally hastate-each lobe distally acute, margins weakly but broadly undulate or entire, abaxial surface usually glaucous; primary lateral veins 3–9 per side, whitish or light green, lighter than the surrounding blade, midvein and lateral veins sunken below the blade on adaxial side of leaf; petioles green to glaucous; inflorescence of 1-numerous spadices, peduncles 20–30 cm long, glaucous or glaucescent; spathe 18–22 cm long and 4 cm wide, chartaceous, pale green to glaucescent, turning cream to peach with age; spadix 6–13 cm long, green to cream or yellowish, appendix 3–4 cm long, fertile staminate region 5–7 cm long, sterile staminate region 3–4 cm long, fertile pistillate region 3.5–5 cm long, pistillate flowers with slight odor of ether; berries ovoid, yellow, 7–10 mm long and 4–8 mm in diameter.

Native to the neotropics and cultivated in Central and South America and the West Indies since pre-Columbian times (Vaughan & Geissler 1997). It was introduced into the United States as an ornamental for its large size, leaves, attractive flowers, and fruit (Bailey 1997; Vaughan & Geissler 1997). *Xanthosoma sagittifolium* is naturalized throughout central and southern Florida and in southern Texas. It is highly rhizomatous and can become an invasive weed in areas of disturbance and adequate moisture. This species has the potential to increase as a weed under favorable conditions.

Plants generally produce large, somewhat elongate, oblong, subterranean tubers along the length or at the end of slender rhizomes or from the base of the crown. Juvenile plants have little or no tuber development; instead they possess a network of fleshy fibrous roots interspersed with elongate slender rhizomes. Large colonies are formed through vegetative propagation by rhizomes. Small to medium sized colonies of immature plants at the rhizome stage are often observed. Such plants likely arise through vegetative fragmentation and subsequent relocation of the rhizome fragments. Dispersal and establishment from seed is also possible but less likely. Although fruit production is not often observed, plants are self compatible, with a single individual or colony producing fruit and viable seed. It can be difficult to determine whether new populations originated from seedlings or from vegetative plant propagules. Vegetative expansion seems a more plausible explanation. This species is probably not distinct from the similar *X. atrovirens* C. Koch and Bouché.

Xanthosoma sagittifolium prefers moderate to high soil disturbance and soil water content. It is generally found in any disturbed area where water collects; along roadside ditches, pond and lake margins, drainage areas, freshwater wetlands, marshy woods, seasonably wet sites, woodland edges, old fields, vacant city lots, roadsides, and home sites. Although *X. sagittifolium* prefers soil conditions that are moderately hydrated to highly saturated, it will grow on mesic slopes and other habitats with well-drained soils, as long as adequate moisture is present. It was observed in both wet and mesic sites in Ocala and Bellview, Florida, in 1996 and 1997. *Xanthosoma sagittifolium* has minimal cold tolerance. It withstands occasional freezing temperatures, but cannot sustain prolonged freezing. Juvenile, unestablished plants are most susceptible to freezing because older plants can regenerate from tubers. The tubers are used as a food source throughout the American tropics and to a lesser extent in the South Pacific and Africa (Bailey 1997; Vaughan & Geissler 1997; Neal 1991). The tubers are similar in chemical composition to those of *Colocasia* or *Alocasia*, but the starch is more difficult to digest (Vaughan & Geissler 1997). In West Africa, the tubers are preferred over those of *Colocasia* for the production of the food substance known as fufu (Vaughan & Geissler 1997).

Xanthosoma sagittifolium is easily cultivated. Vegetative propagation is accomplished through tuber division, rhizome tip development and fragmentation, plantlet removal, and crown division. Small plantlets can be removed from the parent plant at the 2–3 leaf stage so long as the entire stem is intact. Unlike *Colocasia*, rhizomes of *Xanthosoma* are primarily subterranean. Even mature individuals transplant readily.

Common names.—arrowleaf-elephant-ear, elephant-ear, yautia, malanga, tannia, tanier, tanyah, tajer, ocumo, cocoyam.

2. Xanthosoma violaceum Schott, Ind. Sem. Hort. Berol. 370. 1853; Schott in Oest. Bot. Wochenbl. 417. 1854.

Arum nigrum Vell., Fl. Flumin. 9. t. 107. 1829. *Xanthosoma nigrum* (Vell.) Mansf., Verz. Pfl. Deut. Reich. 1940.
Arum variolatum Schott, Prod. Syst. Aroid. 81. 1860.
Xanthosoma ianthium C. Koch & Bouché, Ind. Sem Hort. Berol. 2. 1854.

Caulescent herbs 30–150 cm in height, from a tuberous caudex, stems purple or yellow-green, tubers and tuberous caudex poorly developed or absent in juvenile plants; well-developed rhizomes present to 1 m or more in length, elongate, slender, without scaly covering of cataphylls, often tuberous at various places along the length, white and often tinged with light green or pink coloration; leaves 30–100 cm long and 15–75 cm wide, ovate to triangular-ovate or ovate-oblong, apically acute to acuminate, basally sagittate to hastate—each lobe distally obtuse to acute and unequal, margins weakly but broadly undulate or entire, abaxial surface usually glaucous; primary lateral veins 4–9 per side, purple or rarely a pale yellow-green, midvein and lateral veins sunken below the blade on adaxial side of leaf, petioles usually purple, sometimes yellow-green, older leaves dark green, young leaves blue-purple or yellow-green with purple or yellowish primary or secondary veins; inflorescence of 1-numerous spadices, peduncles 30–50 cm long, glaucous or glaucescent; spathe 7–10 cm long and 3.5–4 cm wide, chartaceous, constricted portion purple to violet, green to yellow-green and violet-striate; spadix 15–25 cm long, initially purple but with age becoming grey or yellowish, appendix absent, fertile staminate region 10–15 cm long, sterile staminate region 3–5 cm long, fertile pistillate region 3–5 cm long, pistillate flowers with slight odor of ether; berries ovoid, yellow, 7–10 mm long and 4–8 mm in diameter.

Cultivated in southern Florida but not strongly naturalized. Plants have been observed spreading vegetatively at sites of cultivation, and eventual establishment outside these conditions is probable. *Xanthosoma violaceum* is cultivated throughout the tropics for its edible tubers similar to *X. sagittifolium*. The exact area of origin (possibly the West Indies) for *X. violaceum* is uncertain, but it originated in the neotropics. Ecology similar to that of *X. sagittifolium*.

Common names.—blue tannia, blue taro, blue ape, tanier, tajer.

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REFERENCES

Bailey, L.H., E.Z. Bailey, and Hortorium Staff. 1997. Hortus third. Cornell University. Barnes and Noble, New York, NY.

Croat, T.B. 1998. Tropical aroids: Taxonomy, diversity, and ecology In: Mathew and Sivadasan, eds. Diversity and taxonomy of tropical flowering plants. Mentor Books, Calicut. Pp. 235–286.

_________. 1988 (1990). The ecology and life forms of Araceae. Aroideana 11(3–4):4–56.

Engler, A. and K. Krause. 1920. Araceae In: A. Engler: Das Pflanzenreich, 4:23, A-F, Leipzig 1905–1920.

French, J.C., M.G. Chung, and Y.K. Hur. 1995. Chloroplast DNA phylogeny of the Ariflorae. In: P.J. Rudall, P.J. Cribb, D.F. Cutler, and C.J. Humphries, eds. Monocotyledons: Systematics and evolution. Royal Botanical Gardens, Kew. Pp. 277–286.

Grayum, M.H. 1984. Palynology and phylogeny of the Araceae. Ph.D. dissertation. Univ. of Massachusetts, Amherst, MS.

Hill, A.F. 1939. The nomenclature of the taro and its varieties. Bot. Mus. Leafl. 7(7). Cambridge.

Mayo, S.J., J. Bogner, and P.C. Boyce. 1997. Genera of Araceae. Royal Botanical Gardens, Kew.

_________. 1995. The Arales. In: P.J. Rudall, P.J. Cribb, D.F. Cutler, and C.J. Humphries, eds. Monocotyledons: Systematics and evolution. Royal Botanical Gardens, Kew. Pp. 277–286.

Neal, M.C. 1991. In gardens of Hawaii. Bernice Pauahi Bishop Museum, Honolulu, HI.

VAUGHAN, J.G. and C.A. GEISSLER. 1997. The new Oxford book of food plants. Oxford University Press, Inc., New York, NY.

YOUNG, R.A. 1946. The dasheen, a southern root crop for home use and market. USDA Farmers' Bull. 1396, Rev. ed.